Subject: Response to Consultation Paper on *Leveraging Artificial Intelligence and Big Data in Telecommunication Sector*
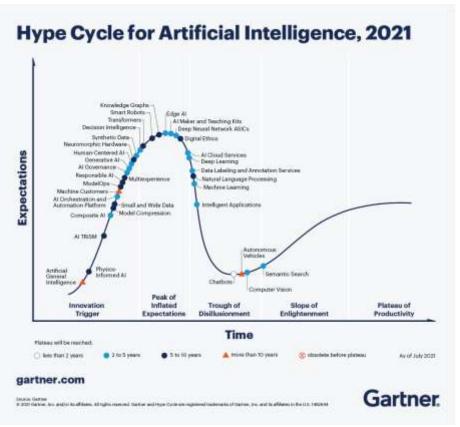
To,
TRAI

Sir,
Please find my response below on consultation paper

Q.1. What may be the most appropriate definition of Artificial Intelligence (AI)? What are the broad requirements to develop and deploy AI models in a telecom sector? Whether any major challenges are faced by the telecom service providers in adopting AI? Please justify your response with rationale and global practices, if any.

Artificial Intelligence has come a long way since it was first coined by John McCarthy in 1956. Focus of AI was on machine-driven intelligence (i.e. non-human intelligence) to enable machine learn and execute functions on their own. Each era has envisioned its own definition of AI and maturity of machine learning evolved with time. Hence it is important to define AI in a reference of time.
If we look at Gartner hype cycle 2021, it shows various AI solutions getting ready in short to longer term timeframe.

Reference: Gartner

Definition of AI by Niti Aayog is an appropriate one in today's context. NITI Aayog in its report on the National AI Strategy defines AI as a *constellation of technologies that enables machines to act with higher levels of intelligence and emulate the human capabilities of sense, comprehend and act while acknowledging the largely accepted definition of AI outlined by scientists such as John McCarthy, Alan Turing, and Marvin Minsky.*

However, AI is witnessing new research and we may revisit the definition at regular interval as this area evolves.

Requirements to develop and deploy AI models in telecom sector is evolving based on telco value chain. Right from network vendors, application players, content and third party platforms, devices and customer, there is evolution of new use cases towards end customer experience, revenue upliftment and cost optimization.

Telcos are adopting AI for process automation and at network side for operational efficiencies through predictive maintenance and operations.

Telcos are also re-engineering processes for bringing proactive customer experience by using ML capabilities built in application products. AI is being introduced at end user and devices through edge and building tinyML approach of power computing and analysis right at end node/device.

AI is an evolving area where there is lot of experimental approach is in progress. Telecom being a regulated industry and telcos are facing few challenges as they introduce AI/ML in their eco-system. There is focus on data governance and privacy followed by regulatory driven needs for compliance and approvals of data usage.

Telcos are also facing two prong imperative, one is to adopt through regulated driven approach for their network and customer information along with competing with growing competition in this area.

Telcos need to create an AI framework and guiding principles as they develop and deploy AI solutions.

For example:

- AT&T has designed their guiding principles for their AI (https://about.att.com/innovationblog/2019/05/our_guiding_principles.html)
- Telia has defined its AI ethics(https://www.teliacompany.com/en/about-the-company/public-policy/ai-ethics/)
- Telcos like Orange are conducting Data-AI challenge for onboarding more start-ups developing innovative and responsible solutions or technologies in the field of AI and Data and to support them through a specific acceleration program.
- BT has defined responsible business(https://www.bt.com/about/digital-impact-and-sustainability/championing-human-rights)
- Vodafone has defined its AI framework (https://www.vodafone.com/about-vodafone/how-we-operate/public-policy/policy-positions/artificial-intelligence-framework)
- As an AI and Digital infra service company, SK Telecom links AI responsibility to human rights (https://www.sktelecom.com/img/eng/pds/persist_biz/2022/SK_Telecoms_Human_Rights_Policy.pdf)

- Jio piloting AI chatbots:
  https://telecom.economictimes.indiatimes.com/news/jio-pilots-ai-chatbot-using-homegrown-5g-ran-and-sa-core/86584171

Another key requirement is quality skilled talent for AI adoption. Telcos are looking for onboarding key skills for growth. In order to create a talent some telcos have launched AI schools and accelerators.
For ex, Jio has launched program in AI and Data science
(https://www.jioinstitute.edu.in/academics/artificial-intelligence-data-science)
Singtel has launched a lab to train people with AI skills
(https://www.zdnet.com/article/singtel-to-open-sg42m-ai-lab-in-singapore/)

Third challenge expected in this area is regulatory. AI being a new area has lot of ambiguity in well defined framework. As new learnings surface up telcos have to continuously create business case and approach for getting regulatory approval for use cases. It is important to build a community around AI and ML in telecom for more smooth transition towards regulatory process.

Q.2. Whether the big data in the telecom sector may be utilised for developing AI models? For efficient and effective handling of big data, whether there is a need for adoption of special programming models or software frameworks? Please justify your response with suitable examples and global practices, if any.

Proliferation of devices and affordable data charges changed the way services are being consumed by consumers and enterprises. Approach for consuming big data itself has changed driven by cloud adoption over past decade. Therefore, it is important for Telcos to adopt both business and software frameworks for big data strategy in alignment to their business imperatives. Big Data strategy requires a process, people and technology driven framework for an efficient and effective handling of Big data covering establishing data governance for identifying right processes for data to be consumed and technology to mine the data in a productive way.
Today, data sources are no longer confined to single hosting location but spread across in a hybrid cloud world. Analysis of data of data across 4Vs- volume, veracity, velocity and variety requires close integration between Telcos/Media companies, Cloud player and Data Cloud platform start-ups and enterprises.
For ex, GDPR regulation clearly defines process on data usage across Europe. It has clear guidelines on why and what data can be used and how it can be used across the consumption chain with an empowered rights to end customer.
Cloud landing zone and hosting is becoming increasingly important with each country laying their own rules looking at high amount of new services being launched.
Cloud products are being launched in this space for better ways for data governance and management.
Many countries are also defining their Cloud strategy, AI guidelines and strategy and Data strategy given the importance of data protection and also national security.

Q.3. Whether deployment of 5G and beyond technologies will help to accelerate adoption of AI in all the sectors and vice versa? Please justify your response with suitable illustrations including global practices, if any.

5G has opened up discussion on new use cases with high bandwidth, low latency and coverage, etc. It has also enabled Telcos and even Cloud players to launch their own private 5G network services.(https://aws.amazon.com/private5g/)

While 5G will be a catalyst in accelerating of AI, it will be more towards the foundation side. There are still barriers in providing seamless connectivity and speed given the ongoing expansion of 5G launches. Even in US, telcos don't have an extensive 5G coverage to a level where AI use cases can ride purely on 5G. EU markets has mixed picture of 5G rollout (https://www.gsma.com/membership/resources/the-mixed-picture-for-5g-in-europe/) while high speed telecom market like Korea is yet to find firm score (https://www.reuters.com/business/media-telecom/skoreas-high-speed-5g-mobile-revolution-gives-way-evolution-2022-05-13/)

Success of AI in sectors depends on dedicated connected solution for edge level computing. There is lot of existing focus for building AI/ML capability right on the last mile edge device (sensors, watches, camera, etc) rather than using them as just data collectors and sending whole data either to edge server or application server on cloud/data center for analysis and ML processing and transmitting it back to end device for action.
Most of the use cases on AR/VR or enterprise are supported mainly on Wi-fi or private 5G network.
Therefore, role of 'beyond technologies' will be critical. 6G is focusing on immersive experience which will help in enabling advanced AI use cases both for consumer and enterprises. Telcos are launching their partnerships with both hyperscalers (Google , T-Mobile), Verizon-Azure, Verizon-Immarsat, T-mobile-SpaceX for improving their connectivity through satellite communication.
Rather than single stream of fiber driven or 5G technology, other doors like cloud and satellite broadband are expected to promote more experimentation of AI use cases in all sectors.

Q.4. Do you think that a number of terminologies such as Trustworthy AI, Responsible AI, Explainable AI etc. have evolved to describe various aspects of AI but they overlap and do not have any standardised meanings? If yes, whether there is a need to define or harmonise these terms? Please justify your response with rationale and global practices, if any.

Transition towards AI has been a journey where key foundation steps defined these terminologies. These were like lego blocks which are being connected together to get a more clear AI framework and this journey will be an ongoing one. Yes, they do overlap with common hooks which helps in connecting them together for defining AI principles.

While they have varied approach and definition, there is a need to harmonize them into industry terminologies and be open about discovering new ones.

Q.5. Which are the applications of AI and BD already being used by the TSPs in their networks to improve Quality of Service, Traffic Management, Spectrum Management and for Security purposes?
Please list out all such applications along with the level of maturity of such applications. Please specify whether they are at trial stage or pilot stage or have reached the deployment stage? Details should include type of AI models, methods to access data, and procedures to ensure quality of data.

No response.

Q.6. What are the major challenges faced by the telecom industry, including policy and regulatory, in developing, deploying, and scaling applications of AI listed in the response to Q.5? How can such challenges be overcome? Please justify your response with rationale and suitable examples, if any.

Taking an approach through telecom value chain, there are areas around network, applications and customer services.

Towards the network side, deploying AI for traffic management requires regulatory compliance to ensure such technologies are not tweaking bandwidth and throttling as per Net Neutrality approach. While ML can detect network anomaly of a device causing a clogging, scaling of such ML applications requires active data refresh of all IMEI and handset type in the market. Therefore, availability of device data and regulatory compliance is key. Creation of cross-industry initiative for sourcing common repository of such information can benefit all the players and control cost of development and deployment of such applications.

Application and third part content is another area of challenge in terms of customer data ownership. Customer data at the device side is a big question around data ownership which leads to development as well as scaling challenge unless right partnership is formed. Device manufacturer are now restricting access to customer data through new privacy rules leading to creation of walled garden approach. In order to create new innovative customer facing applications, this data is critical for testing, training and analysis processes. Similarly, data used by application also require data governance and privacy. For example, GDPR regulations in Europe follows strict rules around data storage and usage. Similar policy decision need to be defined, discussed and complied on an industry wide basis. There is also ethical discussion around to what extent customer data can be used for testing and deployment without explicit permissions.
Customer experience is being enhanced today through AI Bots at store and other physical kiosks. While bot training is being done, there are legal concerns around any accidents by these bots to customer. Similar to automotive industry, where there is an open debate on setting accountability in case of an accident by self-driven car there will be similar scenarios of defining laws through usage of AI Bots.

These challenges can be solved by approaching AI adoption with a well-defined AI framework and guiding principles. This framework will establish key criteria for developing, deploying and scaling of these applications.

Q.7. In which areas of other sectors including broadcasting, existing and future capabilities of the telecom networks can be used to leverage AI and BD? Please justify your response with rationale and suitable examples if any.

Telecom industry is an underline force for cross-sector technology growth and it is also undergoing a convergence with other industries. Power of mobile communication opened up plethora of new business models through which various sectors has underdone transformation and disruption. Mobility empowered sectors to obtain better understanding about their customers through big data riding through various transactions by customers, all on the click of a button.

Transportation industry which was purely driven over phone and call center evolved through new business models of Uber, Lyft, etc which used power of telecom networks and density maps for fleet management and even dynamic pricing. They are adding AI and ML capabilities to automate their customer demand and supply including demography and location driven pricing. Companies like Alphabet backed Waymo have launched robo taxis in US which drives through San Francisco with limited supervision from driver. These are first steps towards autonomous taxis which will still require some decisions taken through central command center all expected to be connected through telecom networks.

Retail industry has launched robots within their warehouse through enterprise grade 5G services to remotely manage multiple supply chain processes.

Financial services industry has witnessed emergence of FinTech which are using power of Big Data for building ML capabilities for various financial offerings which are often real time and location pricing through existing telecom network driven.

Media industry embedded whole entertainment in a device on the move and using the power of network and big data for positioning and pricing their product by new age media players like Hotstar, Disney, Netflix.

Automotive is another industry which is seeing not only tectonic shift from gasoline to EV and Hydrogen fuel but also connected cars driven through connectivity solutions. Telecom will help in bringing predictive maintenance, monitoring, entertainment coupled with various maturity of AI use cases built in the vehicle. These connectivity solutions however can also be by cloud players or satellite players like WebOne, SpaceX, etc.

Growth of Edge computing will further revolutionize automotive industry which will see car's local devices/sensors becoming more powerful through TinyML capabilities.

Q.8. Whether risks and concerns such as privacy, security, bias, unethical use of AI etc. are restricting or likely to restrict the adoption of AI? List out all such risks and concerns associated with the adoption of AI. Please justify your response with rationale and suitable examples, if any.

AI adoption will be a journey and variables around risks and concerns will mature as technology capabilities evolve through learnings and advancements.

Privacy, security, bias and definition of unethical use of AI, etc will always be frame of time reference. Something which is adopted as normal and acknowledged today was seen as a high risk 10 years back. For example, capturing of fingerprints was seen as high privacy risk, however today most of mobile phones are equipped with fingerprint driven unlocking with data going somewhere to phone manufacturers database. With right checks and balances, innovation need to be promoted through an experimentative approach. Based on learnings, risks and concerns need to be mitigated.

Key risk and concerns can be:
1- Ethical use of data for right processes
2- Misuse of data even after blocking permission to use
3- Unplanned events causing harm to customer or a place
4- Triggering any physical damage at network side due to an incorrect technology configuration
5- Access being hacked due to weak security in ML engines
6- Technology has lack of security and unstable due to recent innovation
7- National security and threat

Q.9. What measures are suggested to be taken to address the risks and concerns listed in response to Q.8? Which are the areas where regulatory interventions may help to address these risks and concerns? Please justify your response with rationale and suitable examples, if any.

Adoption of any new-age technologies comes with its associated risks and concerns. Key for successful adoption and obtaining benefits from technology adoption requires an ongoing balance of openness for innovation, scrutiny & regulation for mitigating risks.

Key topic of concern globally is focus on Ethical AI. Given the impact by AI in either positive or negative direction, it is important to empower testing pods for an OpenAI platforms. Ease of transparent declaration to government entities and market along with key approvals required are necessary for AI fail fast, learn fast approach. This will empower more ideas in an open environment rather than ideas being developed in silos and being difficult to track.

OpenAI platform should also regulate data security and governance guidelines for its usage for AI use cases. Any key learnings from other global practices should be updated and incorporated while giving approvals for adopting calculated risks.

Data residency requirements for AI/ML is critical to control law of the land and any potential national threat. AI/ML often uses cloud services which maybe hosted in availability zones outside India. While experiments maybe allowed for cloud services outside India, any production services/use case should be mandated with in-country hosting to secure customer data and applicability of law.

Cyber security capabilities should also be evolved in alignment with AI landscape and changes.

Q.10. What measures do you suggest to instill trust and confidence regarding a robust and safe AI system among customers, TSPs and other related entities/stakeholders? Whether adopting general principles such as Responsible AI and ethical principles at the time of designing and operationalising the Over models will help in developing ethical solutions and instilling trust and confidence in the users? What may be such principles and who should formulate these and how compliance can be ensured? Please justify your response with rationale and suitable examples, if any.

No response

Q.11. Whether there is a need of telecom/ICT sector specific or a common authority or a body or an institution to check and ensure compliance of national level and sector specific requirements for AI? If yes, what should be the composition, roles and responsibilities of such authority or body or institution? Please justify your response with rationale and suitable examples or best practices, if any.

AI/ML is already bringing fast change in industry landscape beyond telecom/ICT sector besides accelerating convergence between telecom and other industries. Therefore, there is definitely a need for an institution to check and ensure compliance at a national level.

Given the impact of AI/ML adoption in telecom on cross-sector imperatives, there should be a common governing body to ensure compliance across the lifecycle of business cases. For example, there is an ongoing adoption of AI through converging business solutions in automotive and telecom industry for connected cars.

Similarly, telcos are working with retailers on bringing AI for end users through AR/VR/Mixed reality solutions across the globe and Indian market will be no different.

Healthcare and Telecom is introducing hypercare for patients through remote connected experience and Virtual reality driven solutions in US markets. Eventually, these use cases will also get introduced in Indian market. Finance and insurance industry is also adopting AI solutions with is actively converging with mobility led solutions.

This common governing body role can be responsible for overseeing National AI adoption and composition can representation from cross-sector regulators, players, customer societies, etc for establishing and monitoring guidelines.

This body can comprise of policy making, research & monitoring areas for ease of collaboration and gathering information.

This body maybe established under Niti Aayog with representation from TRAI, RBI, IRDA, Other regulators, industry bodies like NASSCOM, GSMA, NIC, Consumer Forum, Women and Child protection, Human Rights, etc

Suggestive key roles and responsibilities:

- Research emerging global trends in AI/ML and Big Data
- Impact on Telecom sector due to business disruption in key industries
- Key areas of national importance from AI/ML capabilities

- National security and intelligence
- Role of industry regulators and consultation process
- Emerging trends in technology and cloud for AI solutions
- Liason with industry forums like NAASCOM, CII, Start-up India, NIC, etc on emerging technology focus areas in AI
- Liason with key cloud and technology companies for AI products and solutions and its role in National AI policy
- Identify key areas of national importance and threat for AI policy and solutions
- Monitor key metrics across areas above for success of AI towards better society

Inputs from this team will be consultative in nature and power for decisions should rest with Niti Aayog with government approvals.

Q.12. In response to Q.11, if yes, under which present legal framework or law such authority or body or institution can be constituted and what kind of amendments will be required in the said law? Or whether a new law to handle AI and related technologies is a better option? Please justify your response with rationale and suitable examples or best practices, if any.

AI will come with additional complexity of design and background and requires special skills to understand and adopt for monitoring, controlling any threats and crime prevention.
Key amendments required are enhancement of technology platform and tools with the centralized team, process improvement to incorporate AI related scenarios and outcomes along with focus on training and development of existing team with AI capabilities and thought process.

Q.13. Whether telecom/ICT industry is facing constraints such as access to data, lack of computing infrastructure, lack of standards, and R&D in the adoption of AI and BD technologies? Please list out all such constraints with adequate details.

Telecom/ICT industry has witnessed business and digital transformation as it adopted to new business innovation and customer expectations. There has been evolution of computing infrastructure for Telcos over past decade not only with new technologies but also new operating model through cloud computing. Today, developers can build AI use cases through infrastructure as a code and use pre-built APIs and cloud services and modules(AWS Sagemaker, Azure AI, GCP Tensorflow,etc) which has configured infrastructure for enterprises to channel their focus towards building technical solution without worrying about infrastructure. This has laid good foundation for introducing AI & Big Data capabilities. With recent convergence trends between telcos and cloud players, there has been introduction of services which accelerates implementation of AI/ML capabilities. Therefore, computing infrastructure maybe not a major deterrent.
Data is another area of focus even though telcos have started to invest in their data strategy and inclusion of elementary AI and big data solutions. There is still more

clarity required in terms of data privacy, standards, hosting regulations and how AI use cases impact customer privacy rights and data governance. Implementation of AI solutions host across cross-sector and many time cross-geo scope given the connected world today.

Some of leading AI and BD SaaS or Solutions are headquartered in Silicon Valley, US , Israel , Korea or other parts of tech-world. While usage of cloud can still control data hosting, many of the AI services are not available across availability zones by hyperscalers. There are niche start-ups or AI SaaS companies which may not hosting capabilities in India. This leads to data being hosted outside India and not in direct control of Telcos in terms of data usage and privacy. This is double whammy since it is important to control data privacy by preferring hosting in India but some of the best solution provider may not have extended their technical operations in India as per their market plan.

Edge computing is fast becoming a de-facto component of AI solutions where end devices like sensors are not only capturing data but also being developed as end min-data center zones for even conducting analytics locally within the devices. These devices are still not indigenous and sourced from outside India. Technical protocols are still not hard defined and manufacturers may still have semi-control of these devices and data. Telecom network is sensitive infrastructure and mission critical for country economic backbone. Therefore, scaling AI on this network has some of these areas of concerns.

R&D in telcos was never primary focus in India since most of telecom components were created, build and sourced from global players. With launch of 4G, things have changed a bit since Telcos started changing their dependency of products from just one country. New greenfield launches like Jio has also seen lot of effort on R&D on creating new solutions in India for their data driven strategy while other telcos have also invested in building their AI/BD capabilities. These R&D initiatives will help in building momentum in AI R&D initiatives although there is still long way ahead.

Q.14. What measures are required to make data and computing infrastructure available and accessible to developers and also to make data/AI models interoperable and compatible? Please respond along with examples, best practices and explanatory notes.

There are different types of measures which can help in this area.

First is around business measures by enabling an ecosystem for developers. India has seen good growth in start-up ecosystem over part decade which has helped in bringing a shift in cultural mindset. It is important to continue building on this momentum and promote platforms for building AI solutions. These platforms can be through various entities like Start-up Idea by Govt. of India, Joint industry initiatives, VC accelerators, etc where funding is made available for great ideas in this space.

This first step will promote second step linked towards measures mentioned in the questions. It is important to create right demand and supply equation so that computing infrastructure and Data/AI model creation platform is available to developers. Fundamentally, computing infrastructure for AI is largely driven through cloud platforms since building an on-premise infrastructure with expected agility and scale is a challenging task.

Programs run by platforms in first step will support building AI ideas using cloud with infrastructure-as-a-code approach. Developers can spin-up minimum required compute, network and storage infrastructure including data warehouse and data lake all on cloud for an agile driven development and building their Minimum Viable Product(MVP) and product step by step. Creating an AI-veer program by govt of India as mentioned in response to Q15 can also create a talent base which can utilize power of cloud.

These two steps will create a market for more cloud and AI solution providers to focus on India and create more compliant infrastructure.

While Data interoperability is still possible through common data governance and cloud platforms, there is still some more time before AI can be interoperability. Today, data and AI models are still tied or compatible to different platforms. Prebuild services are provided by different cloud provider and products, however true single pane of control is still a challenge in multi-cloud/solution world. The way forward is to provide developers access to cloud platform of their choice or depending on solution and let the community build solutions on the same. Integration of these solutions for interoperability is still a river to be crossed after sometime.

Q.15. Whether there is a gap between requirement and availability of skilled AI workforce? If so, what measures are required to be taken to ensure availability of adequate skilled workforce in AI domain? Please respond along with suggestions with supporting details and best practices.

Gap between requirement and availability of skilled workforce will always be a challenge for new-age technology. We witnessed the same in area of cloud over past few years and AI is no different in this case.

There is more demand of AI workforce than supply across industries and telecom industry is also witnessing the same. The way forward to fill this gap is through academia tie-up, telecom accelerators, launching govt programs, VC/Industry accelerators to train and build pipeline of AI workforce.

Telecom industry -academia linkages is important for AI related skill development.

Many industry disruptive ideas and companies were incubated within universities or accelerators. For example, leading Big data platform company Databricks was started at Berkely after initial academic project on sparx. Founder of Databricks who was in academia saw the potential of commercial opportunity has started the company. There are many other AI/ML start-ups by students pursuing higher education or working in VC accelerators like YCombinator, etc creating new experiments in this space.

National level campaigns will be useful for getting more skills for India's telecom industry. I want to emphasize what I call as a 'pyramid problem'. Most of the times, these national level programs and their awareness are limited to students of only top technology institutions. While top part of this pyramid gets awareness, their involvement and outcomes are limited for a short period since many of them either leave for higher education abroad or opt for high paying jobs. There is a huge aspirational student talent in bottom of the pyramid which is not exposed to these programs although most of them remain and work in India. If this bottom of the

pyramid is provided equal awareness of these programs, we can get more experiments and ideas which can be pursued to more logical and firm conclusions for benefit of telecom industry.

There can be short term programs rolled out in line of Defence's Agniveer program and funded by either Ministry of Information & Technology or Consortium of PSUs/Telcos/other Private entities. This AI/ML-Veer program can be of 1-2 years through centralized selection and participants works on AI industry use cases and projects. PSU telcos like BSNL has strong training and development infrastructure & facilities which can be utilized for such program leading to win-win scenario for everyone.

This idea is also inspired from YCombinator approach which is VC body in Silicon valley and runs batch every year to fund ideas and mentor them. These ideas get a seed platform to scale the ideas and seen companies like AirBnB, Instacart, Stripe, Sitenna, etc which are applying ML in their business models.

Education platform are getting democratized with famous universities opening up access to online content free and for global consumption. Proven hybrid approach of education can also be explored for getting global exposure and intake of ideas.

Telecom players should launch incentive programs for upskilling their existing employees and run campaigns for promoting AI ideas by employees. It should be major challenge in scaling technical infrastructure to run some of these pilot programs since Ideation and talent is key for success of these programs.

Some initiatives has been started:

AWS has lauched ML summer school-

https://www.amazon.science/academic-engagements/amazon-launches-annual-ml-summer-school-in-india

https://www.dqindia.com/amazon-india-invites-applications-from-students-for-free-online-machine-learning-summer-school/

Online Sumer school by IIT Tirupati- https://iittp.ac.in/mlsummerschool/

Google India summer school- https://sites.google.com/view/aisummerschool2020

Summer school by IIIT Hyderabad- https://cvit.iiit.ac.in/summerschool2021/

Orange will launch its own Centre de Formation d'Apprentis (Apprentice Training Centre or CFA) to support its growth and share its expertise in digital professions

Q.16. What initiatives do you suggest to democratise data required to develop AI models in the telecom sector? Please justify your response with rationale and suitable examples, if any.
No response

Q.17. Whether the authority or body or institution as suggested in response to Q.11 may also be entrusted with the task to manage and oversee collection, cataloguing and storage of data? Whether such authority or body or institution need to be entrusted to generate and make available synthetic data? Please justify your response with rationale and suitable examples, if any.

In continuation of response to Q11, there need to be two prong approach for this area. First one is availability of synthetic data for AI initiatives wherein an authority proposed should have special planning vehicle for data governance. This SPV can be entrusted with management of data including collection, cataloguing and storage of data. As AI solutions are adopted across various maturity cycles, there will be high need for data for learning, training and testing purposes to obtain result close to production use cases. AI model is as strong as the data fed for deep learning. Therefore, it is important to provide cross-entities data for training purposes.

Second point is about data governance for production use cases wherein primary data of customer is being used. It is important to establish data management processes on similar lines like GDPR. Special emphasis is required for regulatory provision to avoid becoming a roadblock due to data usage approvals instead of an enabler of AI growth.

There should be guidelines issues by larger regulatory body and these should be monitored based on industry usage of data for AI advancement from time to time to avoid any deviation from expected approach.

Q.18. Whether the legal framework as envisaged in para 3.5.3 and Q.12 should also enable and provide for digitalisation, sharing and monetisation for effective use of the data in AI without affecting privacy and security of the data? Please justify your response with rationale and suitable examples, if any.

No response

Q.19. (a) Which are the currently used privacy enhancing and privacy preserving technologies facilitating adoption of AI and BD? Are there any challenges in using these technologies? How these challenges can be addressed?
(b) Which are the potential technologies likely to be available in near future to further strengthen privacy? Please justify your response with rationale and suitable examples, if any.
No response

Q.20. Whether the list of technologies provided in response to Q.19 are adequate to handle all the perceived risks and concerns in the AI domain? Or is there a need to develop new privacy preserving architecture? Please justify your response with rationale and suitable examples, if any.
No response

Q.21. Whether the next generation telecom network architectures such as AI at edge, federated learning, TinyML or their combination can offer solutions to meet both privacy as well as intelligence requirements? Please justify your response with rationale and suitable examples, if any.

Next generation telecom network architecture is bringing an impact across the telecom value chain along with control on privacy.

Looking at the value chain from left side, network is undergoing change towards software defined networks with active ML capabilities at the network side. There is

an active integration with application and solutions for connecting network analytics and combining it Application side AI capabilities leading to an improved customer experience and operational efficiencies. This also includes federated learning and edge use cases. There is a lot happening at the device side wherein tinyML is utilizing devices for running analytics processes locally at the edge. Data and integration with third party apps working with service providers are using network side learnings and also provided active insights to telco's application and network deep learning engine. As part of this value chain evolution, entities across the chain are putting defacto focus on privacy. Device and operator side mechanism are witnessing more controlled security and data usage governance. Application and network are keeping secure design for maintaining data secrecy and customer privacy across business processes.

This new design is build mostly on a cloud driven platform and has strongest design principle around privacy by cloud players. There are dedicated guidelines reviewed regularly about privacy requirements.

Q.22. What type of technological advancements are happening for running the AI models on the end user devices to overcome constraints in respect of processor, memory, battery etc.? Whether special tools, programming languages, and skills are required to be developed to build such AI models? Please justify your response with rationale and suitable examples, if any.

Consumer and end user side of Telecom value chain is witnessing active advancement. With power of edge computing and TinyML, there is new power house being discovered to harness. This is leading to advancement in technology components.

Processor are getting more powerful with higher GPU capabilities. For ex, Apple has launched new M2 chip with faster CPU and GPU capabilities, Intel has launched Gaudi2 processor for AI deep learning, Qualcomm focusing on Cloud AI 100, Nvidia DGX, etc. are augmenting their capabilities in AI.

XR including Augmented reality and Virtual reality will enable lot of AI solutions, therefore there is ample innovation in that area. Headsets are becoming more faster and leaner through each version. For ex, Meta's Quest2 is running on Qualcomm Snapdragon XR2 SoC and there is an expected launch of Quest3 in 2023. Apple is also planning to launch its XR headset while Google is testing its AR glasses.

Tesla is rumoured to be working on a phone for its satellite broadband services which can ignite new uses cases focused on market segment in rural areas.

Apple has launched iPhone14 with satellite connectivity capability with Globestar, T-Mobile doing partnership with SpaceX for satellite driven connectivity on mobile phone.

Initially, most of the edge devices were being focused on data collection compute capabilities, with most of the intensive processing being done at cloud or application server side. There is a shift-left pattern for memory wherein in-storage capabilities is being focused on for advanced use cases requiring both compute and storage. There are areas in ORAN where platforms are building PaaS capabilities at the edge.

Power consumption is closely associated feature for an efficiency compute and memory processing. Battery side innovation is also progressed which got a push due to battery research in fast growing EV & automotive space.

Design and size of these components is another emerging criteria given lot of convergent use cases require more lean devices. Edge computing devices are becoming smaller and design compliant to accommodate customer/location centric innovation.

Weather resistance capability is an area where edge devices material is being studied for more rugged variance in temperature, terrain, etc.

These devices are taking various shapes and form. For ex, simple house cleaner product like Roomba has capability to run ML solution and collect trash without any supervision. It can even collect insights about that area and send ML driven processed data to HQ about customer insight and analysis. As usage of new type of products increases for AI use cases, battery, storage and compute will also evolve towards these use cases.

Q.23. Considering availability of new privacy preserving architectures as suggested in response to Q.19 and Q.20, what is the likelihood of emergence of new business and operational models? Whether such models will raise issues related to ownership and responsibilities? What do you suggest to address these issues? Please justify your response with rationale and suitable examples, if any.

No Response

Q.24. Whether the concept of "Operator Platform" would help in providing AI based solutions in a unified and more equitable manner?
Apart from popular federated use cases of edge cloud federation, Cloud XR, Cloud Gaming, whether this concept may also be applied for public service delivery and in making public policies that are data-driven?
Whether there is a need to take initiatives for developing and demonstrating advantages of concept of "Operator Platform"? If so, what steps and measures are suggested to launch such initiatives?
Please justify your response with rationale and suitable examples, if any.

GSMA has proposed the idea of developing a single Operator Platform which, in Phase 1, will "federate multiple operators' edge computing infrastructure to give application providers access to a global edge cloud to run services through a set of common APIs". Additionally, GSMA's Telco Edge Cloud (TEC) group aims to align multi-access edge computing business models, charging principles, and commercial deployments and is currently working with 20+ leading operators to promote the initiative. (Source: GSMA and STL Partners)

There maybe a mix outcome from concept of 'Operator Platform'. While collaboration will compliment operator's strengths and geographic reach for market expansion and unified customer experience, there are multilateral efforts required to ensure service reach when using multi-operator reach. This platform will support elementary AI based solutions where interworking model between heterogeneous edge clouds from different operator are defined.

There is another platform called 'Bridge alliance' in APAC and MEA following same approach. This will create an equitable model of a sort for all operators to be part of AI revolution by leveraging common platforms capability. For ex, an operator in smaller APAC country will still have larger partnership reach to tap into enterprise client having presence outside that country, thereby rolling out AI solutions across borders. This may not be equitable in same proposition and expected to vary as per weightage average of presence but providing a route for smaller players to tap larger markets.

AI solutions also require well connected value chain to bring all component with desired QoS and technology, something this platform can provide.

Besides areas of Cloud XR, Cloud gaming, etc there are opportunities for public service delivery. XR devices which required higher compute tilted towards larger headset. Leveraging edge side of computing through 5G, some of this processing can be moved to edge, thereby making more leaner and faster devices. Gaming will also require faster 5G network side capabilities to providing services in a holistic ways at a global scale. Privacy will be an important component since many of services are being routed outside core device towards hosted cloud.

Operator platform concept is about bringing industry together for creating more win-win situations and business opportunities. There is already an active discussion on ability of 5G to truly capitalize on edge and AI opportunities given challenges in network reach, dedicated speed and latency for advanced use cases. For ex, VR is largely wi-fi driven solution today due to bandwidth need. On the other hand, cloud players are creating an eco-system which can provide much higher QoS and hybrid network capabilities for supporting these edge opportunities including over public service delivery. There will be a comparison by clients between operator platform and cloud led solutions.

Operator platform require stronger continuous approach around customer ownership given customer service touching multiple stakeholder driven value chain. Service request can lead to multilateral challenges if not design properly to support cross geographic presence.

Q.25. Whether there is a need to create AI-specific infrastructure for the purpose of startups and enterprises in the telecom sector to develop and run AI models in an optimised manner? Whether such an infrastructure should cover various real-world scenarios such as cloud AI, edge AI and on-device AI? Please justify your response with rationale and suitable examples, if any.

Telecom sector has witnessed larger technology transformation and changes over past 3 decades. These changes were across value chain right from network to third party apps across device and service provider.

Given complex technical products and services, most of the Indian telcos developed in-house custom solutions as architecture evolved in fast changing wireless business. These in-house legacy applications had higher presence than other COTS or outside products such as Nokia, Ericsson, Application players like Oracle, Siebel, Whatsapp, android, etc. Digital strategy & transformation over last decade emphasized a need

for introducing more COTS and SaaS capability for being more agility, customer centricity and operational efficiency. Enterprise architecture is evolving from monolithic to microservices for creating a more nimble eco-system laying a foundation for more efficient way of AI adoption.

AI solutions are very fast paced and it will be challenging to build in-house capabilities by telcos. Therefore, it is imports to create a start-ups launch pads, enterprise accelerators for creating and developing AI models for telecom sector and introducing them in Telco's EA landscape in an optimized manner. This optimization can be across variables such as business process, application integration, automation financial case, cloud & technical infrastructure, APIs, etc

Telcos worldwide are aligning towards TM Forum's eTOM and other industry framework, therefore these AI model also need to be compliant or aligned with these framework for standardized adoption.

Most of the AI product and solutions are cloud native applications either built as services by hyperscalers or supported for cloud platforms. Usage of cloud platform is also beneficial for using OpEx approach for experimentation and faster agile development therefore it is important to cover Cloud AI. Edge is becoming a central piece in IOT business and witnessing extensive use cases in AI world. While edge started as computing component, today it is being extended with in-built storage and analytics capabilities for faster processing and reducing latency for intensive use cases. TinyML has created capability for processing data and analytics on-device using local device technical capabilities. Even devices are becoming more advanced with in-built ML capabilities using Tensorflow, faster CPU & GPUs and storage. These can be harnessed for AI products and solution by start-up and telecom eco-system.

Q.26. Whether the emerging trends of development of foundational AI models such as GPT-3, Gopher etc. are leading to democratisation of AI space by offering fine-tuned or derived AI models? Whether such a trend will also help in reducing costs for the AI developers? Whether similar approach will help in development of large-scale AI model for the telecom sector? Please justify your response with rationale and suitable examples, if any.
No Response

Q.27. Whether there is a need to establish experimental campuses where startups, innovators, and researchers can develop or demonstrate technological capabilities, innovative business and operational models? Whether participation of users at the time of design and development is also required for enhancing the chances of success of products or solutions? Whether such a setup will reduce the burden on developers and enable them to focus on their core competence areas? Please justify your response with rationale and suitable examples, if any.

Past 2 years has been a good learning ground around hybrid working environment not only for companies but also for education institutions and experimental platforms. Boundaries for collaboration has been disrupted and proven that a physical set-up is not a de-facto way of operating.

While experimental campus is a great idea, its operating model requires a critical thinking since sometimes word 'campus' gets auto-tagged to a physical space where everyone is required to be present in person.

This experimental campus should be envisioned on Hub and spoke model for better reach and connect. Hub should play the role of creating and governing the framework while spokes is where the action happens. Programs based on focused theme and structure should be created across nation enabled by various entities such as telcos, govt. accelerators like start-up India, VCs, Ventures like TiE or Institution incubators.

Emergence of AI/ML landscape has been purely on an experimentative approach given the amount of unknown in this field. While innovators bring in the ideas and researchers validate ideas with academic approvals which was crucial for planting the right seed, startups play their role in taking the seed idea for a commercial launch and validation. Bringing these three together is crucial to prepare the secret sauce to seed the idea, validate and launch it commercially for market feedback and success (or failure).

This framework will provide good threads in bringing creators, innovators and researchers towards a common cause. Power of proven virtual collaboration can be used to expand it beyond physical boundaries.

There can also be short term programs rolled out in line of Defence forces Agniveer program and funded by either Ministry of Information & Technology or Consortium of PSUs/Telcos/other Private entities. AI/ML-Veer program can be of 1-2 years through centralized selection and participants work on AI industry use cases and projects. PSU telcos like BSNL has strong training and development infrastructure and its facilities can be utilized for such programs leading to win-win scenario for everyone.

This idea is also inspired from YCombinator approach which is a Silicon valley VC and runs batches every summer to fund ideas and mentor them. These ideas get a seed platform to scale the ideas and churned out companies like AirBnB, Instacart, Stripe, Sitenna, etc which are applying ML in their business models.

Education platforms are also getting democratized with global universities opening up access to their online content free for global consumption. Proven hybrid approach of education can also be explored for getting global exposure and intake of ideas.

Domain of AI is very experimental in nature and there is an active of Design thinking in building various AI products and solutions. User is often the center for design thinking and hence participation of users at the time of design and development will help in enhancing the chances of success of products or solutions. Creating a product from outside-in perspective increases its resonance in the market adoption.

Whether such a setup will reduce the burden on developers and enable them to focus on their core competence areas is a grey area and answer is- it depends.

Often developers are provided high level design and expected to create the functionality and even use cases based on their experience. This approach has disadvantages of loosing out potential user-centric use cases especially for testing purposes. Therefore, involvement of user will ease effort of developer to understand the end use cases and will also increase the robustness of product.

On the other hand, developers often want to focus on coding and development effort and not always excited to be part of envisioning or business process part of cycle. Involvement of users increases their effort in collaboration and validation with extra set of effort cycle which may be a deterrent for motivation. Overall, AI adoption and involvement of users is a positive step, however its impact will depend on operational set-up in the context and within organization.

Q.28. Whether experiments are required to be backed by regulatory provisions such as regulatory sandbox to protect experimenters from any violation of existing regulations? Whether participation of government entities or authorities during experimentation will help them to learn and identify changes required in the existing regulations or introducing new regulations? Please justify your response with rationale and suitable examples, if any.

Any new experiments require a test bed for validation of hypothesis. These test beds can be defined based on top-down or bottom-up approach which varies based on maturity of area in discussion. Areas which are technologically proven are often good candidates for bottom-up approach and easier for creation of regulatory sandbox. Rules are well-defined, risks, industry standard and regulatory needs are documented and variables are largely listed and controlled. It often helps in using such regulatory sandbox for experimenting given the defined boundaries.

For areas like AI where approach is purely top-down starting with fast moving industry landscape, technology changing by the day, new risks and agreements and geographical variance & more coming into play, it may not be in best interest to require regulatory provisions for all experiments. Through a common CoE or nodal body, reference guidelines can be documented which can be reviewed at regular interval and recommended for experiments.

Sandbox should be used as an enabler for experiment rather than a bounding constraint. For example, an existing regulatory approach maybe based on a hypothesis but if AI can bring more sustainable approach of operating telecom networks such solutions should be provided levy to experiment. This is an area where participation of government entities or authorities be included to provide support as enablers of new regulation or industry validation of new hypothesis. Adoption of AI product and solution will require an aggressive and constant learning curve, therefore restricting innovation in a pre-defined regulatory sandbox may not be in best interest of innovation.

Q.29. In response to Q.27 and Q.28, whether establishing such a campus under government patronage will enable easy accessibility of public resources such as spectrum, numbering and other resources to the researchers? Whether it would be in mutual interest of established private players as well as startups, innovators and enterprises to participate in such experiments? Please justify your response with rationale and suitable examples, if any.

Definition of a 'campus' has got redefined post pandemic, where future of work is seen as hybrid than a physical campus. While hybrid model can be debated, in reality there has been lot of movement of talent from big cities to their native towns given

the opportunity to work remotely. Govt. and regulatory bodies should utilize availability of such talent in remote areas and promote campaigns wherein experts, SME, software engineer working in industry can join and educate people/students in Tier3 cities, town and even villages. India is known for great talent in rural part from where bright students crack tough entrance exams and making a name for themselves in the industry. Imagine, if we can provide them with information through industry folks living locally in that region supported by some resources, we can see bright ideas and MVP coming out in space of AI. There is good reach of 4G networks and data even in remote India and hence internet and access to technology platform is not a challenge. We often underestimated power of Non-Metro and Rural India which is largely driver for India growth engine. For ex, there were questions about usage of UPI in remote parts of India during its launch due to questions like digital reach , education, etc. However, majority of rural India is key driver of UPI push even in remotest part of Ladakh.

Using People, Process and Technology framework shared earlier in Q27, we have coverage of technology in Tier3 and beyond areas, bright people and existing industry workforce, only missing piece is process where a thrust is required to empower and search bright experiments.

Role of government should be of an enabler with required governance through easy accessibility of public resources such as spectrum, numbering and other resources but let industry forces build the implementation framework through public-private partnerships. These entities of startups, innovators and enterprises can participate in such experiments and provide coverage through seed funding for MVPs, organize codethons, etc.

Q.30. Whether active participation in the international challenge programs such as ITU AI/ML 5G challenge will help India's telecom industry in adopting AI? Whether similar programs are also required to be launched at the national level? Whether such programs will help to curate problem statements or help in enabling, creating, training and deploying AI/ML models for Indian telecom networks? What steps or measures do you suggest to encourage active participation at international level and setting up of such programs at national level?
Please justify your response with rationale and suitable examples, if any.

This question requires an approach into smaller parts.

1- Participation in international challenges: There are already active catalyst programs operational through platforms such as TM Forum, ITU where Indian telcos and Technology providers are collaborating for adopting AI. These participation should also be extended to cross-industry programs where AI and Edge is making high impact. While there maybe pockets where AI will make impact only within Telecom industry, larger market facing use cases will be cross-industry. Telcos should get involve with other industry players to define industry driven AI framework and role of telcos and what changes are required at Telcos side for introducing these AI solutions. For example, AI is shaping a strong safety use case in Manufacturing industry where sensors detect anomalies and triggers AI driven actions over private telecom network.

Such use cases require readiness at both manufacturing facilities and telcos network solutions trained with AI capabilities.

2- National level campaigns will be useful for getting more ideas for India's telecom industry. There are opportunities where telcos are actively collaborating and even sharing assets like tower, network, etc. National level campaigns will bring more ideas to learn from individual competencies and apply them at a cross industry level thereby benefitting everyone in the eco-system.

I also want to emphasize what I call as a 'pyramid problem'. Most of the times, these national level programs and its awareness are limited to students of only top technology institutions which is rarely updated at a central level. While top part of this pyramid gets awareness, their involvement and outcomes is limited for a short period since many of them either leave for higher education abroad or opt for high paying jobs. There is a huge aspirational talent in bottom of the pyramid which is not exposed to these programs although most of them remain and work in India. If this bottom of the pyramid is provided equal awareness of these programs, we can get more experiments and ideas which can be pursued to more logical and firm conclusions for benefit of telecom industry.

3- There can be short term programs rolled out in line of Defence forces Agniveer program and funded by either Ministry of Information & Technology or Consortium of PSUs/Telcos/other Private entities. AI/ML-Veer program can be of 1-2 years through centralized selection and participants work on AI industry use cases and projects. PSU telcos like BSNL has strong training and development infrastructure and its facilities can be utilized for such programs leading to win-win scenario for everyone.

4- This idea is also inspired from YCombinator approach which is VC body in Silicon valley and runs batches every summer to fund ideas and mentor them. These ideas get a seed platform to scale the ideas and churned out companies like AirBnB, Instacart, Stripe, Sitenna, etc which are applying ML in their business models.

Education platforms are also getting democratized with global universities opening up access to their online content free for global consumption. Proven hybrid approach of education can also be explored for getting global exposure and intake of ideas.

Q.31. Whether AI/ML developers should launch bounty programs to establish trust in the public about robustness of measures taken by them to protect privacy in their products or solutions? Whether conduction of such programs will help companies or firms to improve their products or solutions? Whether such programs should be conducted under the supervision of the government or an institution established/assigned for this purpose? Please justify your response with rationale and suitable examples, if any.

Launch of bounty programs is a good approach for incremental and experimentative approach of AI/ML ideas. Trust is a one of the challenging pieces of AI operating model given the amount of data required in this area. It will also help in proactively

discover challenges before it results in larger damage. This is a standard practice followed by leading product companies and any discovery of highlighted gaps including privacy, data, etc are financially rewarded to the person exposing it. This will be good pilot and test ground before scaling it out.

Role of government is to facilitate an environment of experimentation and establishing guidelines. In line with Central government motto- 'Minimum Government, Maximum governance', these programs should be conducted by a central body and players with minimum bureaucratic intervention.

Companies operating in AI space are focusing on disruption and tapping large opportunity. They are keen to proactively close loopholes around these important variables to remain competitive and most important customer friendly. Looking at examples from US silicon valley, Germany, Israel, Singapore, etc where these countries have limited intervention into start-ups, emerging technology companies and any fencing around regulatory and compliance areas during experiment phases. This facilitates a culture of risk-reward and increased appetite for innovation.

Q.32. Whether the telecom industry is required to adopt a Machine Learning Operations (MLOps) environment to develop, train, validate and store ML models? Whether there is also a need to establish a DataOps feature store to help MLOps for training purposes? What standardisation is required in terms of interoperability and compatibility for MLOps to function in a federated manner? Please justify your response with rationale and suitable examples, if any.

No response for this question.

Q.33. Whether active participation in the international bootcamp programs such as MIT Bootcamps, Design Thinking Bootcamp by Stanford University etc. will help India's telecom industry workforce to find international developers community, navigate challenges and learn from experiences of others? Whether similar programs are also required to be launched at the national level? What steps or measures do you suggest to encourage active participation at the international level and setting up of such programs at the national level? Please justify your response with rationale and suitable examples, if any.

It is important for academia- industry partnership for India's telecom industry workforce to find international developers community. Besides MIT Bootcamps and Design Thinking by Stanford's d.school which are top rated platform, Telcos can also explore participation in VC accelerators program. Some of Indian telcos are already funding such programs through their venture arm of creating developer's community and funding new ideas including AI.

It is important to capture innovation happening on international platforms and expand presence on these relevant platforms. Given India's high GDP growth and large markets for both telecom and other industries, it provides a good breeding ground for AI opportunities. These global tie-ups will enable an exchange of platforms for international community to be part of breeding Indian telecom AI and

BD ecosystem, thereby bringing new ideas and also providing Indian companies & talent an access to global platform.

MIT provides lot of relevant AI/ML courses which guides participants through the latest advancements and technical approaches in artificial intelligence technologies such as natural language processing, predictive analytics, deep learning, and algorithmic methods to further your knowledge of this ever-evolving industry.
AI solutions changes lot of processes across value chain, hence it is important to understand persona driven thinking. Design Thinking is one such framework which provides an approach of thinking from end-users perspective and bringing an empathy driven approach. Stanford's d-School is world renowned for Design Thinking along with Platforms such IDEO founded by David Kelly who also founded Stanford University's Hasso Plattner Institute of Design, known as the d.school.
These frameworks can accelerate ideation is fast emerging AI landscape.

There can be short term programs rolled out in line of Defence forces Agniveer program and funded by either Ministry of Information & Technology or Consortium of PSUs/Telcos/other Private entities. AI/ML-Veer program can be of 1-2 years through centralized selection and participants work on AI industry use cases and projects. PSU telcos like BSNL has strong training and development infrastructure and its facilities can be utilized for such programs leading to win-win scenario for everyone.
This idea is also inspired from YCombinator approach which is VC body in Silicon valley and runs batches every summer to fund ideas and mentor them. These ideas get a seed platform to scale the ideas and churned out companies like AirBnB, Instacart, Stripe, Sitenna, etc which are applying ML in their business models.
Education platforms are also getting democratized with global universities opening up access to their online content free for global consumption. Proven hybrid approach of education can also be explored for getting global exposure and intake of ideas.

Q.34. Whether the courses or programs related to AI/ML currently being offered by various institutions and universities in India are adequate to meet the capacity and competence required to develop and deploy AI solutions or products in the telecom networks? If not, what additional steps or measures are suggested to fill the gap? Please justify your response with rationale and suitable examples, if any.

Response to this problem statement can be divided into two parts.
First one being introduction of AI/ML as courses in relevant technical courses in universities. While this will provide technical exposure to students, it can be a challenge finding faculties in this area and rolling it out at scale. Industry partnerships should be explored to encourage cloud players and telcos to fund practical hackathon type of events to introduce platforms for students.

Second step is focused on using the power of internet and social media platform. With democratization of data, there are new EdTech start-ups providing innovative ways of teaching and empowering talent to experiment ideas. Telcos can partner

with such platforms along with cloud players to create specific telco and AI/ML programs and run it as a campaign and even fund top ideas. Given that AI/ML solutions are mostly cloud native, it is easy for students to execute these ideas on cloud rather than depending on physical tech infrastructure. Many of the hyperscalers provide free credit for most of the modules, something which can be explore besides including these cloud players in this program. Today, skilled people even with limited technology exposure are entering cloud domain through programs and certifications run by cloud companies. Similar approach can be beneficial for creating such skill pool and talent. Competence development for AI solutions and products can also be extended to existing talent in telecom industry by providing them company funded programs and certification tied to KPIs around implementing their learnings in innovation and new projects.

I want to emphasize what I call as a 'pyramid problem'. Most of the times, these national level programs and their awareness are limited to students of only top technology institutions. While top part of this pyramid gets awareness, their involvement and outcomes are limited for a short period since many of them either leave for higher education abroad or opt for high paying jobs. There is a huge aspirational student talent in bottom of the pyramid which is not exposed to these programs although most of them remain and work in India and often does wonders in both in govt. and private sector. If this bottom of the pyramid is provided equal awareness of these programs, we can get more experiments and ideas which can be pursued towards more logical and firm conclusions for benefit of telecom industry.

Q.35. Whether establishing a system for accreditation of AI products and solutions will help buyers to purchase such solutions or products? If yes, what should be the process of accreditation and who should be authorised or assigned with the task of accrediting such products or solutions? Please justify your response with rationale and suitable examples, if any.
No response

Q.36. Whether creating a framework to prepare a list of prequalified suppliers of AI products or solutions will help industry including government agencies to procure AI products or solutions? Whether there is a need to formulate a standard Code of Conduct or guidelines for AI related procurements? What should be the typical elements of such a Code of Conduct or guidelines including guidelines on trusted source and who should be tasked to formulate such a Code of Conduct or guidelines? Please justify your response with rationale and suitable examples, if any.

Creation of a framework is definitely an important step in this direction. Introduction of AI/ML products and solutions in eco-system requires adoption to different operating model including different skills, mindset and culture. For example, sourcing and procurement can be a part of new operating model that lays guiding principles for supplier evaluation. Given AI is fast evolving area by the day, restricting it to given set of prequalified supplier(s) will impact innovation. This framework can be constructed through an AI CoE steered by industry-government agencies.

Role of AI target operating model should be to utilize CoE for regular updation of definition and AI code of conduct/guiding principles depending on AI maturity in the industry. For example, selection of suppliers for foundational AI stage adoption will have different set of criteria which may have established players, however for experimental stage list of supplier may vary from an established player(s) to maybe 6 months old growing start-up disrupting the space. As an example, if telecom industry is looking for AI partnership in EV automotive space, all the automotive players are new in EV space including old car brands, OEMs and new EV companies.

Given that role of data is critical both for training as well as analysis, operating model will also help in establishing a framework for data governance and privacy. National security is another area of focus for this operating model since AI is now actively being used in cyber warfare by some countries. Telecom is backbone for both connectivity as well as economy and it is important to establish strong security measures while introducing AI products and suppliers. Data hosting is another area which this operating model need to evaluate for security and procurement processes.

Creation of code of conduct and guideline need to a collaborative process with participation from academia, regulators, industry players, govt. agencies and public. All these stakeholders have an equal stake in evolution and adoption of AI in daily processes. Consulting companies with competency in this area can be included to drive process of CoE set-up and execution. They can also bring an outside-in view including global best practices.

Q.37. Whether there is a need to prepare and publish a compendium of guidance, toolkits and use cases related to AI and BD, to foster adoption in the telecom sector? If yes, what should be the process to prepare such a compendium and who should be assigned this task?
Please justify your response with rationale and global best practices, if any.

No response for this question.

Q.38. Whether there is a need to establish telecom industry-academia linkages specifically for AI and BD to accelerate the development and deployment of AI products and solutions? Whether there is a need to establish Centres of Excellence (CoEs) for this purpose or it can be achieved by enhancing the role of existing TCoE? Please justify your response with rationale and global best practices, if any.

Role of telecom industry-academia linkages will be combination of accelerating AI products and solution and skill development as explained in next response.
This can be achieved by expanding scope of existing TCoE since there has been a lot of new development in telecom industry. There is a need of new CoEs for areas where scope has high weightage of cross-industry use cases. For example, edge computing is now using tinyML for harnessing power of device side compute and memory for performing analytics rather than sending all the information all the way to application infrastructure for processing. Such scenario will require collaboration

with mobile phone as well as other devices manufacturer and not just limited to telcos or network providers.

Given an ongoing active convergence between telecom and cloud industry, there is lot of network virtualization happening and being driven by cloud players. Such scenario will also require CoE approach given vast area of coverage between telecom and cloud players.

These CoEs can be under Niti Aayog as primary governance body so that an active collaboration can be establish with other stakeholders in AI area such as industry regulators, key PSUs, Defence bodies like DRDO, Telcos, Govt department such as home ministry and urban transport, etc which are equally focused on introducing AI solutions in their field.

Countries like Israel, Singapore, Canada, US are developing their National AI strategy and blueprinting plan for tie-ups with academia and industry.

Q.39. Whether there is a need to establish telecom industry-academia linkages specifically for AI and BD for AI related skill development?
Please give the suggestions for strengthening the industry-academia linkages for identification of the skill development courses. Please justify your response with rationale and global best practices, if any.

Telecom industry-academia linkages is important for AI related skill development. Many industry disruptive ideas and companies were incubated within universities or accelerators. For example, leading Big data platform company Databricks was started at University of Berkely after initial academic project on Spark. Founders of Databricks who were in academia saw the potential of commercial opportunity and started the company. In Databricks CEO own word "As academics, we were just thinking big and thinking: 'Where does the future go?' It was almost like sci-fi," as quoted in Forbes article.
(https://www.forbes.com/sites/kenrickcai/2021/05/26/accidental-billionaires-databricks-ceo-ali-ghodsi-seven-berkeley-academics/?sh=7d5dd1177008)
There are many other AI/ML start-ups by academia and students pursuing higher education or working in VC accelerators like YCombinator, etc creating new experiments in this space. There is another AI startup in Edge space- OmniML founded by academia from MIT and Stanford University.
There are examples in India where academia is churning out start-ups. IIT Madras faculty founded atleast 94 start-ups.
https://www.hindustantimes.com/india-news/iitmadras-faculty-founded-at-least-94-startups-valued-at-rs-1-400-crore-report-101638716391816.html

One of key reason for academia to be good breeding ground is focus on future mission and avoiding short term revenue pressure. India has strong technical institutes and tie-up with them can help in AI and BD related skill and idea development.

National level campaigns will also be useful for nurturing more skills for India's telecom industry. I would like to emphasize what I call as a 'pyramid problem'. Most

of the times, these national level programs and their awareness are limited to students of only top technology institutions. While top part of this pyramid gets awareness, their involvement and outcomes are limited for a short period since many of them either leave for higher education abroad or opt for high paying jobs. There is a huge aspirational student talent in bottom of the pyramid which is not exposed to these programs although most of them remain and work in India and often does wonders in both in govt. and private sector. If this bottom of the pyramid is provided equal awareness of these programs, we can get more experiments and ideas which can be pursued towards more logical and firm conclusions for benefit of telecom industry.

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Education platforms are also getting democratized with global universities opening up access to their online content free for global consumption. Proven hybrid approach of education can also be explored for getting global exposure and intake of ideas.

Q.40. Any other issue which is relevant to this subject? Please suggest with justification.

I would like to acknowledge that TRAI has been very active in collaboration and consultation on important emerging industry areas. AI/ML will accelerate convergence between telecom and other industries along with bringing changes in their respective industry value chain.

Based on trends, AI/ML will not emerge in silos within telecom or media/broadcasting industry. Telcos need to collaborate work more closely with other industries since important element of data for AI/ML solutions will go beyond telecom platforms.

It will be good to solicitate or collaborate with other industry regulatory bodies on AI/ML approach being taken by players in their respective industries.

From:
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Disclaimer: Views expressed are my personal opinion